

The following text is a working technical document. This draft technical report can be referred to when making out the matrix for Management Issues within the Pocono Watershed.

Please concentrate on TEXT, and the delivery of information. Tables, Maps, Graphs are not yet numbered. The Final Draft will contain all sequential numbering labels. Also, due to the limitations of the WORD program, random page breaks occur, splits in text, etc. These will be corrected in the final copy.

### **Geology, Geomorphology, Geohydrology, and Surface Water Hydrology Of the Pocono Creek Basin**

The Pocono Creek basin is encompassed by two physiographic provinces, the Appalachian Plateau in the northern part of the watershed and the Valley and Ridge in the southern part. The Pocono Escarpment subdivides the Appalachian Plateau province into the Pocono Plateau section in the northwest and the Glaciated Low Plateau section to the southeast. The Appalachian Plateau province is categorized by gently folded rocks of Devonian age, and more than 75% of the watershed lies within its boundaries. The Appalachian Mountain section of the Valley and Ridge province occupies the remainder of the watershed and is characterized by more intensely deformed sedimentary rocks also of Devonian age.

#### **Geologic Structure**

Within the Pocono Creek watershed, the Pocono Plateau escarpment trends from east to west and forms the most prominent topographic feature, Camelback Mountain. The orientation of Camelback Mountain deviates from the more general north to south trend of the Pocono Plateau escarpment due to the occurrence of nearly vertical faulting on the northern flank of the mountain. Faulting across the Pocono Plateau escarpment continues into the southern part of the watershed and is generally perpendicular to the escarpment. The Glaciated Low Plateau section is composed of shale, siltstone and sandstone units that have been gently folded into synclines and anticlines. The fold axes strike from northeast to southwest and plunge to the southwest. The bedding dips 15-25 degrees to the northwest and most bedding planes is influenced by this structural trend, however, smaller-scale anticlines and synclines within the watershed deviate from this trend. The Appalachian Mountain section of the Valley and Ridge province contains more intensely deformed rocks than those of the Appalachian Plateau. This intense deformation is exemplified by the Lehigh Anticline, which trends northeast to southwest, and is found just outside the Pocono Creek watershed in the Broadhead Creek and the McMichael Creek basins.

#### **Geomorphology**

The topography of the Pocono Creek watershed reflects many influences from continental glaciation. Glacial deposits of both Illinoian and Wisconsin age overlie much of the watershed bedrock to varying thickness based primarily on the province or section of a particular location.

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The Pocono Plateau section contains numerous glacial features including terminal moraine deposits and u-shaped valleys. The Glaciated Low Plateau section of the Appalachian Plateau and the Valley and Ridge province sections in the Pocono watershed also show glaciation effects; however, the preglacial topography still dominates in these areas. Glacial deposits on this topography vary greatly in their thickness and areal extent, whereas the Pocono Plateau deposits are more uniform.

Glacial sediments throughout the Pocono Creek watershed are composed of differing percentages of gravel, sands, and clay that have been derived primarily from the underlying bedrock. The deposition categories are divided into till and stratified drift and can be further subdivided on the basis of location and composition within the glacial regime. Some of the more prominent features in the watershed and adjacent areas are formed as a result of glacial and post glacial activity. The Cranberry Swamp appears to have formed from scouring during glacial advance with subsequent peat deposition and accumulation during glacial retreat. During the period of glacial retreat, post-glacial lakes formed, and flow from one of these lakes began to drain eastward toward the Delaware River thereby enhancing formation of the nearby Delaware Water Gap. Remnant glacial lakes are prominent in the watershed and often form what is called a Paternoster Lake, a small series of lakes in a glacial valley usually separated by moraines and connected by streams. Other features include kettle lakes, kame terrains and various types of moraine deposits.

**Geohydrology**

Most ground-water supply development in the watershed occurs in the bedrock units. These bedrock units have low primary porosity and permeability; however, post depositional fracturing and deformation has increased secondary permeability. Fracturing and faulting associated with the regional deformation of the bedrock into synclines and anticlines provide preferential pathways for groundwater flow. Well yields are strongly controlled by structure. Wells completed near a fold axis, fractures or other enhanced secondary permeability features usually encounter more permeable strata and have increased yields. Wells not completed near a fold axis or encountering secondary permeability features likely exhibit reduced yields. Structural control also influences well drawdowns where anisotropic cones of depression are expected to be parallel to the geologic strike.

**Description of Geologic Formations and Members in the Pocono Watershed**

The stratigraphic column in Figure \_\_\_\_ provides a generalized description of the formations and members of the underlying geology in the watershed and some of their hydrologic properties. The table is organized stratigraphically from youngest to oldest and begins in the northwestern portion of the watershed in the Pocono Plateau section.

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GEOLOGIC DESCRIPTION		FORMATION OR MEMBER	ENVIRONMENTAL CHARACTERISTICS
Z	Gray sandstone and conglomerate with minor red siltstone and shale; forms low ridges southwest of Pecos Pkwaas escarpment; blocky, shaly, rubbly, hard; about 350 feet (107 m) thick.	DISCANSION MEMBER	<p>Poor to good aquifer potential.</p> <p>Excavation requires blasting; slow to moderate drilling rates; excellent foundation stability.</p> <p>Possible use as fill material or riprap.</p>
	Gray sandstone and conglomerate with minor red siltstone and shale; forms low ridges southwest of Pecos Pkwaas escarpment; blocky, shaly, rubbly, hard; about 350 feet (107 m) thick.	PIPIER GAP MEMBER	<p>Good aquifer potential.</p> <p>Excavation generally requires blasting. Slow to moderate drilling rates; excellent foundation stability; some reddish or shale potential.</p> <p>Potential for flagstone, riprap, or fill.</p>
	Gray sandstone and conglomerate with reddish tinge; forms low cliffs at Pecos Pkwaas escarpment; blocky, shaly, rubbly, about 400 feet (122 m) thick.	FOUNDERMAN MEMBER	<p>Good aquifer potential.</p> <p>Excavation requires blasting; moderate to slow drilling rates; excellent foundation stability; but has shale laminations; potential for rockfall.</p> <p>Some flagstone potential; good riprap source; possible use as decorative dimension stone (conglomerate).</p>
	Alternating gray sandstones and red siltstone and shale in thinning upward fluvial cycles; sandstones platy, lumpy, shaly; siltstone and shale shaly, blocky, rubbly; approximately 2,800 feet (853 m) thick; involved in several ridges, open folds.	LONG RUN MEMBER	<p>Sandstone has good aquifer enveloped in red-bed aquifers.</p> <p>Shales and siltstones moderately easily excavated; sandstones require blasting for excavation; drilling rates variable; possible rockfalls in shale horizons when saturated; careful planning required for arrangement of concrete walls and septic systems; good foundation stability.</p> <p>Local source of medium-grade flagging; possible clay products from red shales; red siltstone favorable for road base or fill material.</p>
Z	Light-olive-gray sandstone with siltstone and shale; bears marine fossils; forms low ridges; shaly, blocky, rubbly, hard; average thickness, 125 feet (38 m).	BLAVERMAN RUN MEMBER	<p>Good aquifer potential—laterally persistent.</p> <p>Variable excavation difficulty; sometimes requiring blasting; moderate to slow drilling rates; excellent foundation stability; some potential for rockfalls where currently (saturated) with shales.</p> <p>Possible limited source of flagstone; may give service as riprap or road base.</p>
	Alternating gray sandstone and red siltstone and shale in thinning upward fluvial cycles; sandstone lumpy to blocky; siltstone and shale rubbly and shaly or lumpy; forms isolated with few low ridges supported by sandstone; average thickness 125 feet (38 m).	WALKERVILLE MEMBER	<p>Sandstone good aquifer enveloped in red-bed aquifers.</p> <p>Shales and siltstones moderately easily excavated; sandstones require blasting; variable drilling rates; possible rockfalls where saturated interbedded shales rubbly; good foundation stability; some possible problems with septic systems.</p> <p>Some potential for flagstone and structural clay products.</p>
		SYMBOLS	
		<p> <b>Contact</b>            Dashed when approximately located; short dashed when inferred; dotted when concealed.            Dashed showing interdigitation relationship between units.            Dotted when approximately located; short dashed when inferred.         </p> <p> <b>Bedding</b>            Indicated by strike and dip of beds.            Note: In all cases, the strike and dip of bedding symbols is as the exact location where data were obtained. Other structural symbols based on readings at the same point are projected as near as possible to the bedding symbol location.         </p> <p> <b>Bedding and dip of joints</b>            Indicated by strike and dip of joints.         </p>	

A formation is a body of rock identified by lithographic characteristics and stratigraphic position. A member is a subset of a formation and contains some characteristics of the formation in which it belongs. For example, there are seven members of the Catskill formation in the Pocono creek watershed, and each of them shares similar geologic age and general type of depositional environment. Average yields in the bedrock units generally fluctuate from 15 to 50 gallons per minute (gpm) as shown in table 1.

**TABLE 1.--**Yields for geologic formations and members found in the Pocono Creek basin

<b>Formation or Member</b>	<b>Range in Yields (gpm)</b>	<b>Average Yield (gpm)</b>
Marcellus Formation	10-30	unknown
Mahantango Formation	3-50	15
Trimmers Rock Formation	3-50	unknown
Towamensing member (Catskill Fm.)	unknown	50
Walcksville member (Catskill Fm.)	5-60	19
Beaverdam Run member (Catskill Fm.)	5-60	20
Long Run member (Catskill Fm.)	> 100	19
Packerton member (Catskill Fm.)	Unknown	Unknown
Polar Gap member (Catskill Fm.)	3-200	23

#### Surface Water Hydrology

Low and average (mean) streamflow conditions in the Pocono Creek basin reflect the geology and geomorphology described above in that the secondary porosity in the bedrock and the glacial deposits which overlay most of the watershed can store significant amounts of precipitation. Since streamflow during baseflow and most of the mean flow periods of no precipitation or snow melt is a function of ground water discharge from storage, measurements of such flow and statistics derived there from can be used to describe both the expected recurrence probabilities of specific streamflows and the relative availability of ground water.

The results from an analysis of streamflow gaging records for the nearby Bush Kill and Brodhead Creek basins and baseflow measurements made in the Pocono Creek is shown in table 2, which contains selected flow statistics for Pocono Creek near Stroudsburg. Additional measurements reflect similar flow characteristics throughout the basin on a per square mile drainage area basis. Baseflow, as mentioned above, is streamflow derived only from ground-water discharge. The various recurrence intervals are the mean baseflows which could probably occur

**TABLE 2.—**Selected streamflow statistics for Pocono Creek near Stroudsburg

<b>Period or Recurrence Interval</b>	<b>Flow (gpm)</b>	<b>Period or Recurrence Interval</b>	<b>Flow (gpm)</b>
January mean daily baseflow	26,500	January mean daily streamflow	40,400
February mean daily baseflow	28,700	February mean daily streamflow	42,200
March mean daily baseflow	40,800	March mean daily streamflow	60,600
April mean daily baseflow	42,600	April mean daily streamflow	61,000

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May mean daily baseflow	31,900	May mean daily streamflow	44,900
June mean daily baseflow	20,200	June mean daily streamflow	28,700
July mean daily baseflow	13,500	July mean daily streamflow	18,900
August mean daily baseflow	10,800	August mean daily streamflow	15,700
September mean daily baseflow	10,300	September mean daily streamflow	16,600
October mean daily baseflow	12,600	October mean daily streamflow	21,100
November mean daily baseflow	21,500	November mean daily streamflow	34,100
December mean daily baseflow	27,400	December mean daily streamflow	43,500
Mean daily baseflow	24,200	Mean daily streamflow	35,900
		Median daily streamflow	24,200
2-year recurrence baseflow	23,800		
5-year recurrence baseflow	19,700	Q <sub>7.2</sub> Streamflow	4,900
10-year recurrence baseflow	18,000	Q <sub>7.10</sub> Streamflow	3,000
20-year recurrence baseflow	16,200		
50-year recurrence baseflow	14,400		
100-year recurrence baseflow	13,500		

every 2 years (50 percent chance in any year) through every 100 years (1 percent chance in any year). The mean daily streamflows include both baseflow and overland flow during periods of precipitation. The “Q” streamflows are the lowest 7-day means that could be expected every 2 years (50 percent chance in any year) or every 10 years (10 percent chance in any year). When compared to similar statistics computed for streams elsewhere in Pennsylvania, these values are relatively high on a per square mile of drainage area basis, indicating that the Pocono Creek watershed has a substantial ground-water resource.

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